

Question		Answer	Marks	Guidance
1	(a)	<p>any two from: replaces essential elements (used by previous crop) / provides extra essential elements / provides two named essential elements (1)</p> <p>(more) nitrogen used to make plant protein (so increased growth) / nitrogen used to make amino acids (1)</p> <p>(more) phosphorus used to make ATP (1)</p>	2	<p>ignore reference to nitrates, ammonium and phosphates</p> <p>ignore reference to minerals and nutrients</p> <p>the essential elements are nitrogen, phosphorus and potassium</p>
	(b)	20 / twenty (1)	1	
	(c) (i)	potassium hydroxide (1)	1	<p>allow KOH</p> <p>allow potassium carbonate / potassium hydrogencarbonate / K_2CO_3 / $KHCO_3$</p> <p>ignore potassium oxide</p>
	(ii)	hydrogen ions reacted with hydroxide ions (to make H_2O) (1)	1	<p>allow $H^+ + OH^- \rightarrow H_2O$</p> <p>allow H^+ react with OH^-</p> <p>allow H^+ counteracted by OH^- / H^+ balanced by OH^-</p>
		Total	5	

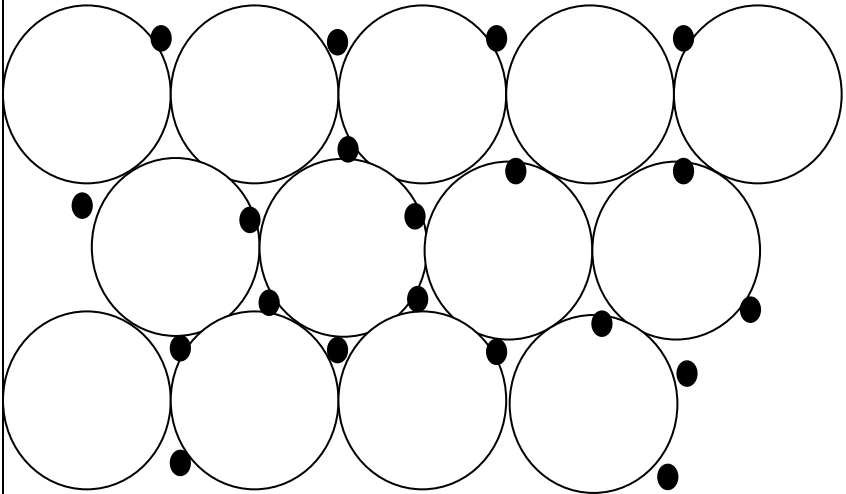
Question			Answer	Marks	Guidance
2	(a)	(i)	ammonia is needed in large amounts / ammonia is needed in high demand / AW (1) drugs or medicines are made on a relatively small scale / easy to switch to making a different drug / drugs are needed in small amounts / AW (1)	2	allow ammonia needed all year round allow demand for drug may be seasonal allow a batch can be re-called if there is a problem
		(ii)	making drugs is more labour intensive / more specialised or qualified workers to make a drug / less automation is possible when making drugs / more research and testing in drug manufacture / raw materials for drug manufacture may be rare or expensive to extract from plants / legislative demands (1)	1	allow ora for fertiliser labour costs are high is not sufficient more workers is not sufficient allow idea of need to have careful testing (of batches) / idea need to have more quality control
	(b)	(percentage yield = $\frac{\text{actual yield}}{\text{predicted yield}} \times 100$ (1) but $\frac{6.0}{8.0} \times 100$ (2)	2	allow $\frac{\text{am}}{\text{pm}} \times 100$ (1) or $\frac{6.0}{8.0} = 0.75$ (1) 0.75 x 100 (1) No mark for 75%
		(ii)	any two from: to reduce wasting reactants (1) to reduce costs / to make more money / to make more profit (1) saves wasting energy (1)	2	ignore reduces waste / reduces waste products / waste materials to make money is not sufficient / to make a profit is not sufficient / to save money is not sufficient
			Total	7	

Question		Answer	Marks	Guidance
3	(a)	idea of reduces costs (1)	1	allow saves starting materials ignore can be reused allow improves percentage yield allow idea of increased sustainability allow to make sure nothing is wasted
	(b)	36 (%) (1)	1	allow any value between 35 and 36
	(c) (i)	pressure = 600 (atmospheres) and temperature = 350(°C) (1)	1	both required
	(ii)	iron catalyst used to speed up the reaction (1) reaction is too slow or slower at 350°C and a higher temperature decreases percentage yield (1) idea that very high pressures are expensive to generate or a lower pressure decreases percentage yield (1)	3	allow idea that optimum conditions give the lowest cost rather than the fastest reaction or highest percentage yield for one mark if no other mark
		Total	6	

Question		Answer	Marks	Guidance
4	(a)	salt (1)	1	
	(b)	acid – nitric acid / HNO_3 (1) base – potassium hydroxide / KOH (1)	2	allow potassium oxide / K_2O (1) allow potassium carbonate / K_2CO_3 (1) allow potassium hydrogencarbonate / KHCO_3 (1)
	(c)	20 / twenty (1)	1	
Total			4	

Question		answer	Marks	Guidance
5	(a)	pharmaceutical drugs may be wanted on demand / pharmaceutical drugs are not wanted all the year round / only small amounts of pharmaceutical drugs are needed / you can make a range of drugs not just one (1)	1	allow batches can be tracked
	(b)	any two from more labour intensive / larger workforce (1) need to have specialised workers / need to have trained personnel (1) rare raw materials / starting materials difficult to get hold of (1) less automation possible (1) legislative demands / costs of patents (1) need to have sterile conditions / need to have a high purity product produced (1)	2	ignore any cost related to testing have to pay workforce or labour costs are not sufficient allow have to employ scientists expensive starting materials not sufficient allow need to do lots of marketing but ignore references to advertising
	(c)	any two from animal rights protesters may make scientists not use animal testing / people believe that testing of drugs on animals is cruel (1) government legislation has banned certain types of testing / testing on animals is now limited by laws (1) other scientists have invented testing regimes rather than to use animals (1) risk of bad publicity from accidents to human volunteers (1)	2	allow people have a moral or religious objection to animal testing allow people think testing on people will ensure drug is safe allow computer modelling allow people do not trust animal testing / testing on animals may not have same effect as on people allow too dangerous to test on people (because it can have devastating effects)
		Total	5	

Question	Answer	Marks	Guidance
6 a	$\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$ <p>correct reactants and products (1)</p> <p>balancing – dependent on correct reactants and products (1)</p>	2	<p>allow any correct multiple, including fractions</p> <p>allow = / \rightleftharpoons instead of \rightarrow</p> <p>not and / &</p> <p>balancing mark is dependent on the correct formulae but allow 1 mark for a balanced equation with minor errors in subscripts / formulae</p> <p>e.g. $\text{CH}_4 + 2\text{O}_2 \rightarrow \text{CO}_2 + 2\text{H}_2\text{O}$</p>
b	<p>(sea water because)</p> <p>any two from:</p> <p>removes more of the pollutant / removes 9% more of nitrogen dioxide / 99% of nitrogen dioxide removed (1)</p> <p>does not form a waste product (1)</p> <p>cheap(er) (1)</p> <p>readily available (near the coast) (1)</p> <p>OR</p> <p>(limestone because)</p> <p>idea of does not have to be pumped (a long way) from the sea (1)</p> <p>need less mass of material (1)</p>	2	<p>No marks for sea water or for limestone – the marks are for the explanation</p> <p>allow does not produce waste (1)</p> <p>allow only a small amount needed (1)</p>
Total		4	

Question	Answer	Marks	Guidance
7 a	<p>C</p> <p>high(est) heat conductivity (1)</p> <p>high melting point (1)</p>	2	<p>no mark for choice</p> <p>allow a (very) good heat conductor</p> <p>allow will not melt when heated on a stove / does not melt easily</p> <p>allow A due to a (fairly) high melting point (1)</p> <p>allow D due to good heat conductivity (1) and either high melting point or low density / lightweight (1)</p> <p>ignore light</p> <p>ignore other properties</p>
b	<p>idea of (close packed) positive metal ions (1)</p> <p>idea electrons interspersed within the particles drawn / sea of electrons / delocalised electrons (1)</p> <p>electrons can move / free electrons / electrons can carry the current (1)</p>	3	 <p>Large circle labelled positive ion / metal ion / cation</p> <p>Small circle labelled electron / e / e⁻ but just a negative sign is not sufficient</p> <p>Mention of intermolecular forces / covalent bonds / ionic bonds can only score the electrons can move mark</p>
Total		5	

Question		Answer	Marks	Guidance
8	(a)	ethene + water → ethanol (1)	1	allow = instead of → allow correct symbol equation $C_2H_4 + H_2O \rightarrow C_2H_5OH$ or C_2H_6O allow steam for water
	(b) (i)	C_3H_7OH (1)	1	allow C_3H_8O allow any order of atoms
	(ii)	correct displayed formula (1) $ \begin{array}{cccccccc} & H & H & H & H & & & \\ & & & & & & & \\ H & -C & -C & -C & -C & -O & -H & \\ & & & & & & & \\ & H & H & H & H & & & \end{array} $	1	allow displayed formula for methylpropan – 1 – ol or methylpropan – 2 – ol or butan-2-ol allow OH in displayed formula with no bond between O and H

Question	Answer	Marks	Guidance
(c)	<p>Level 3 (5–6 marks) Discusses at least one advantage and at least one disadvantage of each process AND identifies the better process fully justifying their choice. Quality of written communication does not impede communication of the science at this level.</p> <p>Level 2 (3–4 marks) EITHER Discusses at least one advantage and at least one disadvantage of each process OR Gives two comments (either advantages or disadvantages) about each process AND identifies the better process and gives a reason for that choice Quality of written communication partly impedes communication of the science at this level.</p> <p>Level 1 (1–2 marks) Gives two comments (either advantages or disadvantages) about each process OR identifies the better process and gives a reason for that choice Quality of written communication impedes communication of the science at this level.</p> <p>Level 0 (0 marks) Insufficient or irrelevant science. Answer not worthy of credit</p>	6	<p>This question is targeted at grades up to A/A*</p> <p>Indicative scientific points may include: Relevant points include for hydration process: advantages</p> <ul style="list-style-type: none"> • making ethanol from ethene is a much quicker process • ethanol can be produced 24/7 from ethene • pure ethanol made so it does not need to be purified • making ethanol from ethene does not produce any waste products as the atom economy is 100% • UK has access to North sea oil. • made by a continuous process <p>disadvantages</p> <ul style="list-style-type: none"> • ethene has to be manufactured from crude oil • crude oil (ethene) is a non renewable source • uses a lot of energy. <p>Relevant points include for fermentation process: advantages</p> <ul style="list-style-type: none"> • making ethanol from sugar is greener as the raw sugar is renewable / can be grown • energy costs are cheaper because a lower atmospheric pressure and a lower temperature than hydration is used • catalyst used is not corrosive since it is an enzyme found in yeast <p>disadvantages</p> <ul style="list-style-type: none"> • ethanol has to be purified • takes a long time to make • climate not suitable • uses large areas of arable land. • atom economy not 100% (if carbon dioxide not used) • made in a batch process <p>Use the L1, L2, L3 annotations in Scoris; do not use ticks</p>
	Total	9	

Question		answer	Marks	Guidance
9	(a)	zinc + copper sulfate → copper + zinc sulfate (1)	1	allow = instead of → not and or & in equation allow reactants and products in any order not copper(II) as one of the products allow mix of words and correct formulae ignore state symbols allow correct symbol equation even if not balanced $Zn + CuSO_4 \rightarrow Cu + ZnSO_4$ allow correct name with an incorrect formula but not incorrect name with correct formula
	(b)	iron or top reaction loses electrons which is oxidation (1) oxygen or bottom reaction gains electrons which is reduction (1)	2	no mark for identifying which reaction is oxidation and which is reduction allow water gains electrons which is reduction
		Total	3	

Question		Answer	Marks	Guidance															
10	(a)	<table border="1"> <thead> <tr> <th>acid</th> <th>base</th> <th>salt</th> </tr> </thead> <tbody> <tr> <td>sulfuric acid</td> <td>copper oxide</td> <td>copper sulfate</td> </tr> <tr> <td>nitric acid</td> <td>sodium carbonate</td> <td>sodium nitrate (1)</td> </tr> <tr> <td>hydrochloric acid (1)</td> <td>zinc oxide</td> <td>zinc chloride</td> </tr> <tr> <td>sulfuric acid</td> <td>magnesium oxide / magnesium hydroxide / magnesium carbonate (1)</td> <td>magnesium sulfate</td> </tr> </tbody> </table>	acid	base	salt	sulfuric acid	copper oxide	copper sulfate	nitric acid	sodium carbonate	sodium nitrate (1)	hydrochloric acid (1)	zinc oxide	zinc chloride	sulfuric acid	magnesium oxide / magnesium hydroxide / magnesium carbonate (1)	magnesium sulfate	3	<p>allow correct formulae i.e. NaNO_3 (1)</p> <p>HCl (1)</p> <p>$\text{MgO} / \text{Mg(OH)}_2 / \text{MgCO}_3$ (1)</p>
acid	base	salt																	
sulfuric acid	copper oxide	copper sulfate																	
nitric acid	sodium carbonate	sodium nitrate (1)																	
hydrochloric acid (1)	zinc oxide	zinc chloride																	
sulfuric acid	magnesium oxide / magnesium hydroxide / magnesium carbonate (1)	magnesium sulfate																	
	(b)	$\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$ formulae correct (1) balancing (1)	2	<p>balancing mark is dependent on correct formulae but allow one mark for balanced equation with minor errors of subscripts, superscripts, etc eg $\text{CACO}_3 + 2\text{HCl} \rightarrow \text{CaCl}^2 + \text{CO}_2 + \text{H}_2\text{O}$</p> <p>not and or & for + allow = instead of \rightarrow allow correct multiples eg $2\text{CaCO}_3 + 4\text{HCl} \rightarrow 2\text{CaCl}_2 + 2\text{CO}_2 + 2\text{H}_2\text{O}$</p>															
	(c)	$\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$ (1)	1	<p>order of reactants unimportant allow OH_2 / HOH allow correct multiples subscripts and superscripts must be correct eg H^2O scores 0</p>															

Question		Answer	Marks	Guidance
	(d)	<p>Level 1 (1 mark) idea that fertiliser or nitrates increase the growth of water plants or that the outcome is that living organisms in the water die. idea that fertilisers cause water to become toxic limits mark to a maximum of 1</p> <p>Level 2 (2 marks) idea that (algal bloom) / plant growth blocks off sunlight (from other plants which then die).</p> <p>Level 3 (3 marks) idea that in addition to level 2, (aerobic) bacteria use up the oxygen in the water.</p>	3	<p>Use ticks in this question Mark scheme is hierarchical – level 1 is required before level 2 can be awarded and levels 1 & 2 required before level 3 can be awarded</p> <p>allow algal bloom for increased growth of water plants</p> <p>idea that fertiliser kills or poisons fish (0)</p> <p>allow idea that plants below surface cannot photosynthesis for level 2</p> <p>allow decomposers or microbes or micro organisms for bacteria</p>
		Total	9	

Question		Answer	Marks	Guidance
11	(a)		1	<p>allow formula with or without 'n' after bracket</p> <p>allow formula without brackets</p> <p>allow a section of the polymer drawn eg with at least two repeat units</p> <p>answer must have free bonds at either end but bonds do not have to cross the bracket</p>
	(b)	<p>any two from:</p> <p>insoluble in water / does not dissolve in water / water-proof / leak-proof / not porous (1)</p> <p>does not corrode / does not react with water (and air) / non-biodegradable (1)</p> <p>non-toxic (1)</p>	2	<p>ignore does not rust</p> <p>allow strong</p> <p>ignore hard / hard wearing / tough / low density / lightweight</p>
	(c)	<p>(i) weak intermolecular forces / forces or bonds between polymer chains are weak (1)</p> <p>so polymer molecules can slide over one another / intermolecular forces are easy to break / AW (1)</p>	2	<p>allow polymer chains are not connected together</p> <p>allow it has no cross-linking</p> <p>allow no bonds between polymer chains</p> <p>any reference to bonds within the molecule are weak or weak</p> <p>covalent bonds scores 0 marks</p> <p>allow molecules are easy to separate (from one another)</p>
		<p>(ii) cross links (between the polymer molecules) / strong bonds between the polymer molecules (1)</p>	1	<p>allow strong intermolecular bonds</p> <p>allow covalent bonds between polymer molecules</p> <p>ignore strong intermolecular forces</p> <p>ignore polymer has strong bonds – must have idea of bonds between polymer molecules</p>
Total			6	